EFFECTS OF REPRODUCTION UPON VEGETATIVE GROWTH OF SOME PHOTOPERIODICALLY SENSITIVE PLANTS

BY

JUSTIN HERMAN REINHART

A.B., Augustana College (Illinois), 1947
M.S., University of New Mexico, 1948

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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IN THE GRADUATE COLLEGE OF THE
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Various investigators have studied the correlation between vegetative and reproductive activities of plants. Several species, including cucumber, tomato, and cotton, have been studied. In general the investigations have shown that development of fruits depresses growth of vegetative organs, and that such inhibition can be prevented by defruiting. The evidence has shown also that the depression of vegetative growth cannot be completely explained on the basis of monopoly of available nutrients by the fruits. Consequently it has been suggested that the fruits may exert control over the general metabolism of the plant through a hormone mechanism. In addition, it has been shown that, in some species, fertilization of the ovules results in a temporary stimulus of vegetative activity.

The soybean is a photoperiodically sensitive species. Plants of the variety Biloxi become reproductive if the daily light periods are short and remain vegetative if the daily light periods are long. Experiments have shown that defruiting of soybeans does not prevent inhibition of vegetative growth. Therefore the suggestion has been made that the short photoperiod exerts a direct inhibitive effect on the plants. There are also plant species which become reproductive only under long photoperiods, remaining vegetative under short days and usually exhibiting a short-stemmed rosette of leaves under these circumstances. Investigations have shown that the elongation of the stem is controlled by day length, and the evidence indicates that the influence of photoperiod on stem growth is independent of initiation of reproduction.

The experiments of the author were undertaken in an attempt to verify the existence of a photoperiodic control of vegetative functions as separate from the influence of photo-

period on reproduction. It was also desired to determine the effects of fruiting on vegetative growth of some short day and long day species through defruiting of plants grown under several different photoperiods.

In this investigation soybean (*Glycine max* Merr., var. Biloxi), a short day variety, and two species which are reported to exhibit a long day reproductive response, *Salpiglossis sinuata*, Ruiz and Pav., and China aster *Callistephus chinensis*, Nees, were grown under various photoperiods, and disbudding and defruiting treatments were carried out. Records were kept of numbers of leaves, stem lengths, numbers of flower buds and fruits, and of other morphological characteristics. Samples were taken periodically throughout the growth periods, and from these the fresh and dry weights, nitrogen contents, and carbohydrate contents of various plant organs were determined. An experiment was carried out in which indoleacetic acid was applied to soybeans to determine its effect on vegetative-reproductive correlation.

The vegetative condition of soybeans is characterized by large leaves, long internodes, a light green color of the leaves, and continuous growth of the main stem. If reproduction is initiated the leaves formed subsequently are smaller, the internodes near the stem tip are very short, the color of the leaves is dark green, and the rate of stem elongation is very slow.

Neither removal of flower buds nor of young fruits resulted in any increase of vegetative growth in soybeans. This has been interpreted by other workers as meaning that the inhibition of growth is due to the short photoperiods necessary to initiate flowering. However, inhibition was always accompanied by initiation of the reproductive state. In one instance in which a reproductive and a vegetative plant were developed under identical photoperiods the characteristic inhibition of growth was evident in the former, while the latter was uninhibited.

The evidence indicates that the inhibition is not due primarily to the short photoperiod. It is possible that initiation

of floral primordia is the primary cause of inhibition. The effect may be exerted through cessation of activity of terminal meristems accompanying floral initiation.

Chemical analyses showed that nitrogen was not lacking in vegetative organs of reproductive plants. Thus inhibition cannot be attributed to monopoly of nitrogen by developing fruits. Starch storage, primarily in leaves, accompanied inhibition of vegetative growth. Some evidence was secured which indicated that setting of fruits may initiate hydrolysis of starch in leaves.

Application of auxin did not materially change the vegetative-reproductive correlation, although it postponed the onset of reproduction and the resulting inhibition of vegetative activity.

Fruiting was shown to cause abscission of flower buds and inhibition of new bud formation in soybeans.

The length of the daily light period was found to determine the rate of stem elongation of China aster. The cessation of stem growth was effected by formation of inflorescence primordia, since China aster is a species of determinate growth habit. This species does not exhibit a typical long day response, since floral structures are formed even on short days, although their inception is somewhat delayed, particularly if the light intensity is low.

Salpiglossis sinuata was found to react as a typical long day species. Under short daily light periods the plants remained in a rosette stage, no stem elongation occurring. In long light periods rapid stem elongation took place, followed by flowering and fruiting. The response to long day was not caused by greater nutrient supply from the increased time available for photosynthesis since the rosette plants under short days accumulated as much dry weight over the same period of time as the fruiting plants under long days.

In both the short day and long day species the moisture content of the vegetative parts declined as the plants became

mature. The decline in moisture was partly attributable to increased age of tissues, and the rate of decline was accelerated by initiation and development of reproductive structures.

VITA

Justin Herman Reinhart was born July 2, 1921, in Rock Island, Illinois. He was graduated from Rock Island High School in 1939 and entered Augustana College in Rock Island. He enlisted in the Army Air Force in 1943. Upon his discharge from the army in 1946 he re-entered Augustana and received the degree of Bachelor of Arts from there in 1947. During the academic year 1947-1948 he was a Graduate Assistant in Biology at the University of New Mexico, receiving the M.S. degree from that institution in 1948. From September 1948 until August 1950 he was a Graduate Assistant in Botany at the University of Illinois. Since September 1950 he has been a University Fellow.

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He is married to the former Frances Burns of Rock Island, Illinois and they have two children.

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